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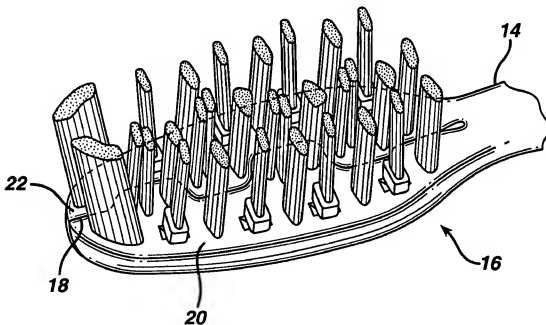
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(57) Abrégé/Abstract:

A toothbrush includes a head and a tooth cleaning element extending from a top surface of the head. The head is divided into at least two portions which can be moved independent of each other. The tooth cleaning element is rotatable relative to that portion of the head from which it extends. A vibrator vibrates the head and tooth cleaning element.



# **ABSTRACT**

A toothbrush includes a head and a tooth cleaning element extending from a top surface of the head. The head is divided into at least two portions which can be moved independent of each other. The tooth cleaning element is rotatable relative to that portion of the head from which it extends. A vibrator vibrates the head and tooth cleaning element.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A toothbrush, comprising:  
a head;  
a tooth cleaning element extending from a top surface of the head, the tooth cleaning element being rotatable relative to that portion of the head from which it extends; and  
a vibrator for vibrating the head and tooth cleaning element.
2. The toothbrush of claim 1, wherein the vibrator includes an electric motor.
3. The toothbrush of claim 2, wherein the electric motor has an eccentric weight secured to an output shaft of the motor which causes vibration when the motor is energized to rotate the output shaft.
4. The toothbrush of claim 2, further comprising a battery for providing electrical power to the motor.
5. The toothbrush of claim 4, wherein the battery is a non-rechargeable, disposable battery.
6. The toothbrush of claim 2, further comprising a switch for controlling a flow of electricity to the electric motor.
7. The toothbrush of claim 1, wherein the tooth cleaning element is a tuft of bristles.
8. The toothbrush of claim 1, wherein the tooth cleaning element is a fin made of a material selected from the group of materials consisting of plastic, rubber and combinations thereof.
9. The toothbrush of claim 1, wherein the tooth cleaning element has a range of rotation of up to about 30 degrees.
10. The toothbrush of claim 1, wherein the tooth cleaning element can rotate up to about 15 degrees to either side of a vertical position in which the element is perpendicular to a top surface of the portion of the head from which it extends.
11. The toothbrush of claim 1, further including one or more stationary tooth cleaning elements which substantially cannot be rotated.
12. The toothbrush of claim 1, wherein a portion of the head limits rotation of the tooth cleaning element.

13. The toothbrush of claim 1, wherein there is no portion of the toothbrush itself which rotates the tooth cleaning element.
14. The toothbrush of claim 1, wherein the tooth cleaning element is supported for rotation primarily about only one axis.
15. The toothbrush of claim 14, wherein the axis is substantially perpendicular to a long axis of the element.
16. The toothbrush of claim 1, wherein the tooth cleaning element is rotatable independent of any other tooth cleaning elements on the head.
17. A toothbrush, comprising:  
a head which is divided into at least two portions which can be moved independent of each other; and  
a vibrator for vibrating the head.
18. The toothbrush of claim 17, further including one or more stationary tooth cleaning elements which substantially cannot be rotated.
19. The toothbrush of claim 17, wherein the two portions of the head define an opening in an interior portion of the head such that water can flow through this opening.
20. The toothbrush of claim 17, wherein each head portion includes alternating projections and recesses, the projections of each head portion fitting at least partially into the recesses of the other head portion.
21. The toothbrush of claim 20, wherein one of the projections on one of the head portions has at least one tooth cleaning element extending therefrom and is surrounded on three sides by the other head portion.
22. The toothbrush of claim 17, wherein the vibrator includes an electric motor.
23. The toothbrush of claim 22, wherein the electric motor has an eccentric weight secured to an output shaft of the motor which causes vibration when the motor is energized to rotate the output shaft.
24. The toothbrush of claim 22, further comprising a battery for providing electrical power to the motor.
25. The toothbrush of claim 24, wherein the battery is a non-rechargeable, disposable battery.
26. The toothbrush of claim 22, further comprising a switch for controlling a

flow of electricity to the electric motor.

27. A toothbrush, comprising:

a head;

a tooth cleaning element extending from a top surface of the head, the head being divided into at least two portions which can be moved independent of each other, the tooth cleaning element being rotatable relative to that portion of the head from which it extends; and

a vibrator for vibrating the head and tooth cleaning element.

28. The toothbrush of claim 27, wherein the vibrator includes an electric motor.

29. The toothbrush of claim 28, wherein the electric motor has an eccentric weight secured to an output shaft of the motor which causes vibration when the motor is energized to rotate the output shaft.

30. The toothbrush of claim 28, further comprising a battery for providing electrical power to the motor.

31. The toothbrush of claim 30, wherein the battery is a non-rechargeable, disposable battery.

32. The toothbrush of claim 28, further comprising a switch for controlling a flow of electricity to the electric motor.

33. The toothbrush of claim 27, wherein the tooth cleaning element is a tuft of bristles.

34. The toothbrush of claim 27, wherein the tooth cleaning element is a fin made of a material selected from the group of materials consisting of plastic, rubber and combinations thereof.

35. The toothbrush of claim 27, wherein the tooth cleaning element has a range of rotation of up to about 30 degrees.

36. The toothbrush of claim 27, wherein the tooth cleaning element can rotate up to about 15 degrees to either side of a vertical position in which the element is perpendicular to a top surface of the portion of the head from which it extends.

37. The toothbrush of claim 27, further including one or more stationary tooth cleaning elements which substantially cannot be rotated.

38. The toothbrush of claim 27, wherein a portion of the head limits rotation

of the tooth cleaning element.

39. The toothbrush of claim 27, wherein there is no portion of the toothbrush itself which rotates the tooth cleaning element.

40. The toothbrush of claim 27, wherein the tooth cleaning element is supported for rotation primarily about only one axis.

41. The toothbrush of claim 40, wherein the axis is substantially perpendicular to a long axis of the element.

42. The toothbrush of claim 27, wherein the tooth cleaning element is rotatable independent of any other tooth cleaning elements on the head.

43. The toothbrush of claim 27, wherein the two portions of the head define an opening in an interior portion of the head such that water can flow through this opening.

44. The toothbrush of claim 27, further comprising a second tooth cleaning element, wherein one of the two tooth cleaning elements is located on one of the two head portions, and the other of the two tooth cleaning elements is located on the other of the two head portions.

45. The toothbrush of claim 44, wherein both of the tooth cleaning elements are located on the same head portion.

46. The toothbrush of claim 27, wherein each head portion includes alternating projections and recesses, the projections of each head portion fitting at least partially into the recesses of the other head portion.

47. The toothbrush of claim 46, wherein one of the projections on one of the head portions has at least one tuft extending therefrom and is surrounded on three sides by the other head portion.

48. A toothbrush, comprising:

a head;

a tooth cleaning element extending from a top surface of the head, the tooth cleaning element being oriented at an acute angle relative to that portion of the top surface of the head from which it projects; and

a vibrator for vibrating the head and tooth cleaning element.

49. The toothbrush of claim 48, further including one or more additional tooth cleaning elements which extend from the top surface of the head at one or more acute angles, each of the tooth cleaning elements extending at an acute angle which

differs from the acute angle of the other tooth cleaning element(s).

50. The toothbrush of claim 48, further including one or more additional tooth cleaning elements each at an acute angle to the top surface of the head, each tooth cleaning element extending in a direction which differs from the direction of the other tooth cleaning element(s).

51. The toothbrush of claim 48, wherein the tooth cleaning element is at an angle of between about 65 to about 85 degrees from the top surface of the head.

52. A toothbrush, comprising:

a head;

a tooth cleaning element extending from a top surface of the head, the tooth cleaning element having a cross-section which is non-circular in shape; and a vibrator for vibrating the head and tooth cleaning element.

53. The toothbrush of claim 52, wherein the tooth cleaning element has a cross-section of a prolate ellipsoid with flattened long sides.

54. The toothbrush of claim 52, wherein the tooth cleaning element has a free end that defines a plane which is non-perpendicular to a direction in which the element extends away from head.

55. The toothbrush of claim 52, wherein the tooth cleaning element has a free end that is other than flat in shape.

56. A toothbrush, comprising:

a head;

a plurality of tooth cleaning elements extending from a top surface of the head, the tooth cleaning elements extending different heights above the top surface of the head; and

a vibrator for vibrating the head and tooth cleaning elements.

57. The toothbrush of claim 56, wherein the tooth cleaning elements have different cross-sections.

58. The toothbrush of claim 56, wherein the tooth cleaning elements are oriented at different acute angles from each other relative to a top surface of the head.

59. The toothbrush of claim 56, wherein the tooth cleaning elements have different cross-sections, and wherein the tooth cleaning elements are oriented at different acute angles from each other relative to a top surface of the head.

60. A toothbrush, comprising:

a head;

a tooth cleaning element extending from a top surface of the head, the tooth cleaning element being comprised of a thermoplastic elastomer; and  
a vibrator for vibrating the head and tooth cleaning element.

61. The toothbrush of claim 60, wherein the tooth cleaning element is in a form selected from a group of forms consisting of a nub, tuft of bristles, fin, cup and wall.

62. A toothbrush, comprising:

a head;

a tuft of bristles extending from a top surface of the head, the bristles being selected from a group of bristles which (a) are tapered at their free ends, (b) are flagged at their free ends, (c) are hollow, (d) are crimped, (e) have a cross-shaped cross-section, (f) have a triangular cross-section, (g) are flocked, and (h) are notched;  
and

a vibrator for vibrating the head and tooth cleaning element.

63. A toothbrush, comprising:

a head;

a tuft of bristles extending from a top surface of the head, the bristles having different characteristics from each other selected from the group of characteristics consisting of material composition and diameter; and  
a vibrator for vibrating the head and tooth cleaning element.

64. A toothbrush, comprising:

a head made of two or more different materials;

a tooth cleaning element extending from a top surface of the head; and  
a vibrator for vibrating the head and tooth cleaning element.



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## TOOTHBRUSH

The invention relates generally to the field of oral care, and in particular to toothbrushes. More specifically, the invention relates to a toothbrush that vibrates.

US Patent 5,987,681 discloses an electric toothbrush with a handle, a brush head and a shank which connects the handle to the brush head. A rotary motor is arranged in the handle and drives an unbalanced mass. The unbalanced mass driven by the motor is supported on one side or on both sides in the shank close to the brush head and is driven by an extended drive shaft, preferably an intermediate shaft, by the motor. When the motor is operated the toothbrush head vibrates.

10       The toothbrush disclosed in the '681 patent is typical of vibrating toothbrushes in that the features on the head of the toothbrush are fairly standard. For example, the bristles 21 on the head 2 are arranged in tufts lined up in straight rows and columns. The free ends of the bristles define a fairly flat surface. The vibrating aspect of the toothbrush has not been combined with any other more advanced head features to enhance cleaning of the oral cavity.

      A Japanese patent document having an application number of 3-312978 discloses a toothbrush having a multiplicity of tufts of nylon bristles. In a first embodiment shown in Figures 1, 2 and 3, a plurality of cylindrical recessed sections in the head are set orthogonally to the longitudinal axial direction of a shank and are  
20       formed at equal intervals. Column-shaped rotary bodies 5 are respectively contained in the recessed sections. On the peripheral surfaces of the rotary bodies 5, along the axial direction, projected strip sections 5a are formed, and they are set in a state that they are positioned at the opening sections of the recessed sections. At the opening sections of the recessed sections, contact surfaces to be positioned on both the sides are formed. At both the ends of the upper surfaces of the projected strip sections 5a, nylon bristles 6 are arranged to be vertically erected.

      As shown in Figure 3, the arrangement described above allows bristles 6 to rotate during use of the brush. A problem with this brush is that two tufts of bristles are secured to each strip section 5a and thus must rotate in unison. As a result, an  
30       individual tuft of bristles cannot rotate independently of its "partner" tuft. The individual tuft may thus be prevented from achieving optimal penetration between two

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teeth during brushing because the partner tuft might contact the teeth in a different manner and interfere with rotation of the individual tuft.

Figures 4, 5 and 6 disclose a second embodiment in which each tuft of bristles is secured to the head by a ball and socket type arrangement. While this embodiment allows each tuft of bristles to swivel independent of the other tufts, it does have disadvantages. If a tuft of bristles is tilted out towards the side of the head and that tuft is positioned near the interface between the side and top surfaces of the teeth, chances are increased that the bristle tips will not even be in contact with the teeth during brushing. Further, the random orientation in which the tufts can end up after brushing detracts from the attractiveness of the brush.

The Japanese reference also discloses that the brush head is made of a unitary structure. As such, water cannot flow through any central portion of the brush head, thereby inhibiting the cleanability of the brush. Further, the unitary head structure does not allow different portions of the head to move independently of each other. Accordingly, the bristle tufts extending from the tuft cannot accommodate the varying tooth surfaces as well as a brush in which the head has two or more portions that can move or flex independent of each other.

The present invention is directed to overcoming one or more of the problems set forth above. Briefly summarized, according to one aspect of the present invention, a toothbrush includes a head and a tooth cleaning element extending from a top surface of the head. The tooth cleaning element is rotatable relative to that portion of the head from which it extends. The toothbrush further includes a vibrator for vibrating the head and tooth cleaning element.

According to another aspect of the invention, a toothbrush includes a head which is divided into at least two portions which can be moved independent of each other. The toothbrush also includes a vibrator for vibrating the head.

In accordance with a third aspect of the invention, a toothbrush includes a head and a tooth cleaning element extending from a top surface of the head. The head is divided into at least two portions which can be moved independent of each other. The tooth cleaning element is rotatable relative to that portion of the head from which it extends. A vibrator vibrates the head and tooth cleaning element.

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These and other aspects, objects, features and advantages of the present invention will be more clearly understood and appreciated from a review of the following detailed description of the preferred embodiments and appended claims, and by reference to the accompanying drawings.

FIG. 1 is a perspective view of the toothbrush head;

FIG. 2 is a top view of the head of Fig. 1;

FIG. 3 is a side view of the head of Fig. 1;

FIG. 4 is a bottom view of the head of Fig. 1;

FIG. 5 is a side view of the head of Fig. 1 showing one of the head  
10 portions flexing;

FIG. 6 is a top view of the head of Fig. 1 with the two head portions separated from each other;

FIG. 7 is a top view of the head of Fig. 1 after the head portions have been positioned closer to each other;

FIG. 8 is a front view of a pivoting tuft taken along the lines 8-8 of Fig.  
13;

FIG. 9 is a side view of the pivoting tuft of Fig. 8 taken along lines 9-9;

FIG. 10 is a top view of one of the holes in the head for receiving the pivoting tuft (see Fig. 6);

FIG. 11 is a sectional view of Fig. 10 taken along lines 11-11;

FIG. 12 is a sectional view of Fig. 10 taken along lines 12-12;

FIG. 13 is a side view of the head of Fig. 1 (a portion is removed to facilitate viewing) and a pivoting tuft prior to insertion into the head;

FIG. 14 is a side view of the head of Fig. 1 (a portion is removed to facilitate viewing) and a pivoting tuft after insertion into the head;

FIG. 15 is a side view of the pivoting tuft showing its motion;

FIGs. 16A-C are sectional views of Fig. 15 taken along the lines  
16A-C-16A-C;

FIG. 17 is a perspective view of a tooth cleaner in the form of a ribbed  
30 fin;

FIG. 18 is a side view of the ribbed fin of Fig. 17; and

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FIG. 19 is a side view in partial section of a toothbrush disclosing another embodiment of the invention.

Beginning with FIGs. 1-5, there is shown a toothbrush head 16 which extends from a neck 14 which extends from a handle (not shown) to form a toothbrush. The type of handle is not germane to the present invention. The head and handle are preferably made of polypropylene. The head has a serpentine split 18 which divides the head into two portions 20 and 22. An end of the split 18 near neck 14 is preferably circular in shape (see Fig. 2). As shown in Fig. 5, the split in the head allows portions 20 and 22 to flex or move independent of each other during use of the toothbrush, thus facilitating cleaning of the teeth.

Split 18 can also be defined as an opening in the head between head portions 20 and 22. This opening allows water to flow through the head, thereby enhancing cleaning of the top head surface which typically gets caked with toothpaste in spite of efforts to rinse the head clean.

Head portion 20 includes a projecting part 24 which fits (at least partially) into a recess 26 (see Fig. 6) defined by portion 22. Projecting part 24 has several tufts of bristles extending from it (to be described in further detail below) and is surrounded on three sides by head portion 22.

Referring now to Figs. 2 and 3, each of the tufts of bristles (tooth cleaning elements) on head 16 will be described. A first pair of tufts 28 are located towards the free end of the head, one on each head portion 20, 22. Each tuft has bristles (tooth cleaners) which preferably are each made of polybutylene-terephthalate (PBT) and have a diameter of .007 inches. The shortest bristles in tuft 28 have a length of .420 inches with the remaining bristles increasing in length steadily to a tip of the tuft. Each tuft tilts away from the handle by an angle of preferably about 12 degrees relative to that portion of the surface of the head from which it projects. As shown in Fig. 2, tufts 28 have a larger cross-section than any other tuft on the head.

A second group of tufts are pivoting tufts 30 (the only tufts on the head which are rotatable). There are four tufts 30 on each head portion 20, 22 which are located towards the outside of the head. Each tuft 30 can pivot up to about 15 degrees to either side of a vertical position on the head, more preferably being able to pivot up to

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about 8 degrees to either side of a vertical position on the head. The pivoting of tufts 30 is roughly towards or away from neck 14. Each tuft 30 includes a base support 32 made of polypropylene. The bristles are made of polyamide 6.12, have a diameter of .008 inches and extend .420 inches above the base support.

A third group of tufts 34 extend perpendicular to the head. There are four tufts 34 on each head portion 20, 22 which alternate with tufts 30. When viewed from the top (Fig. 2) the tufts are oval in shape (similar to tufts 30 but larger). In other words, the tufts 34 and 30 have oval shaped cross-sections. Each tuft 34 has bristles which are made of polyamide 6.12, have a diameter of .006 inches and extend above the head by about .385 inches.

A fourth group of tufts 36 are located towards the inside of the head. There are two such tufts on each head portion 20, 22. Each tuft 36 extends perpendicular to the head. The bristles of tuft 36 have a diameter of .006 inches, are made of polyamide 6.12 and rise about .360 inches above the head.

A fifth and final group of tufts 38 are also located towards the inside of the head (away from a perimeter 21 of the head). There are 4 pairs of tufts 38. In each pair one tuft is closer to neck 14 than the other tuft. In each pair of tufts 38, (a) a base of one tuft is closer to a first side of the head and this one tuft leans towards a second side of the head, and (b) a base of the other tuft is closer to the second side of the head and this other tuft leans towards the first side of the head. As such, the tufts in each pair lean across each other. The angle of tilt towards the side of the head is about five degrees. Each tuft 38 bristles which are made of PBT, have a bristle diameter of about .007 inches and extend about .460 inches above head 16. Each tuft 38 has an oval cross-section with a long dimension of the oval being oriented in the direction of tilt.

The bristles used on the head can be crimped (see US Patent 6,058,541) or notched (see US Patent 6,018,840). Other types of tooth cleaners besides bristles can be used. For example, a tuft of bristles could be replaced by an elastomeric fin. The US Patents listed in this paragraph are incorporated herein by reference.

Turning now to Fig. 6, a description will now be provided as to how the toothbrush (head) is made. In a first step, the head, neck and handle of the toothbrush are injection molded in a mold. During this injection molding step, tufts 28, 34, 36 and

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38 are secured in the head by a hot-tufting process. Hot-tufting processes are notoriously well known by those skilled in the art (see e.g. U.S. Patents 4,635,313; and 6,361,120; British patent application 2,330,791; and European patent application 676,268 A1).

Briefly, hot-tufting involves presenting ends of a multiplicity of groups of plastic filaments into a mold. Each group of filament ends inside the mold is optionally melted into a blob. Each filament group is cut to a desired length (either before or after being introduced into the mold) to form a tuft of bristles. The mold is closed and molten plastic is injected into the mold. When the plastic solidifies, it locks one end of the tufts of bristles into the head of the toothbrush.

It can be seen in Fig. 6 that the opening 18 between head portions 20 and 22 is much wider at this point than in the heads final form (see Fig. 2). In other words, head portions 20 and 22 are spaced a predetermined distance (preferably at least about 1mm) from each other. Further, through holes 40 are created during the molding step for receiving pivoting tufts 30 at a later point in the manufacturing process. Holes 40 will be described in greater detail below.

With reference to Fig. 7, after the toothbrush is removed from the mold, heat 42 is applied to the head near the neck and to part of the neck (hereinafter the neck). The heat can be applied in a number of ways including hot air, radiant heating, ultrasonic or convection (e.g. hot oil) heating. Here the heat is shown being applied to the sides of the neck. It is preferable to apply the heat to the top and bottom surface of the neck. The heat brings the plastic up to 1.0 - 1.12 times its glass transition temperature (when temperatures are measured in the Kelvin scale). The plastic should not be heated above 1.12 times its glass transition temperature in order to avoid damaging the plastic. More preferably, the plastic is heated to about 1.03 - 1.06 times its glass transition temperature (measured in degrees Kelvin). The glass transition temperature for polypropylene is about 100 degrees centigrade whereas the glass transition temperature for copolyester and polyurethane is about 65 degrees centigrade.

Pressure 44 is then applied to head portions 20, 22 to move the portions towards each other. Once head portions 20, 22 are in the position shown in Fig. 2, the heated portion of the head/neck is cooled by, for example, exposing the heated portion

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to a cold gas or liquid. If room temperature air is used to cool the neck, such air should be applied for about 20-25 seconds. This has the effect of forming the two head portions into their final positions.

In order to achieve short process times, the highest temperature heat source which will not damage the plastic should be used. If too hot a heat source is used and/or if the heat is applied for too long, the plastic can be damaged. If the heat source is not hot enough, the process will take too long and/or head portions 20, 22 will not remain in their final desired positions. If the head/neck are made of polypropylene and hot air is used to heat the neck, (a) the heated air should be at a temperature of about 170 degrees centigrade and should be applied to the neck for about 70 seconds, (b) the polypropylene should be raised to a temperature of about 140 degrees centigrade, and (c) a nozzle which applies the hot air to the neck should be about 10mm from the neck.

If copolyester or polyurethane is used as the material for the head neck, (a) the heated air should be at a temperature of 250 degrees centigrade and should be applied to the neck for about 10 seconds, (b) the material should be raised to a temperature of preferably 95-100 degrees centigrade, and (c) a nozzle which applies the hot air to the neck should be about 15-20mm from the neck.

Heating the respective materials above for the time indicated allows the material to be softened and mechanically bent into its final form. Exceeding the heating times above could cause the material to overheat and become damaged.

Turning to Figs. 8 and 9, each pivoting tuft 30 has a multiplicity of bristles 46, a base support 48 and an anchor pivot 50. The bristles are secured to and extend from a first end 52 of the base support while a first end 54 of the anchor pivot extends from a second end 56 of the base support. The base support and anchor pivot are preferably a unitary structure made of the same material. Anchor pivot 50 includes a first portion 58 near the first end 54 and a second portion 60 near a second end 62 of the anchor pivot. First portion 58 is smaller in an X and Y dimension than second portion 60. Base support 48 is larger in an X and Y dimension than second portion 60 of the anchor support. Second portion 60 includes a pair of lips 63. The anchor pivot defines an opening 64 therethrough.

Tuft 30 can also be made by a hot-tufting type process as described

above. Instead of injecting plastic into the mold to form a toothbrush handle, neck and head, the plastic is injected into a mold to form base support 48 and anchor pivot 50, capturing bristles 46 when the injected plastic cools.

With reference to Figs. 10-12, through holes 40 (Fig. 6) will now be described. Each hole 40 extends from a top surface 66 of the brush head through a bottom surface 68. Hole 40 includes first and second portions 70 and 72. Portion 72 is substantially a parallelepiped except that some of its lower section is rounded off (see Fig. 11). Portion 70 is also substantially a parallelepiped except that two of its sides are flared to the sides by about 15 degrees (see Fig. 12). Hole portion 72 is longer in a dimension A than hole portion 70 (Fig. 11). Hole portion 70 has about the same width in a dimension B as hole portion 72 where hole portions 70 and 72 meet (Fig. 12). Dimensions A and B are substantially perpendicular to each other in this embodiment. A pair of lips 73 are defined by this arrangement.

Turning now to Figs. 13-16, the insertion of pivoting tufts 30 into holes 40 will be described. A tuft 30 is positioned over a hole 40 with end 62 of anchor pivot 50 facing the hole (Fig. 13). As shown in Figs. 16A-C, tuft 30 is moved towards hole 40 until end 62 starts to enter the hole (Fig. 16A). Tuft 30 is then pressed into the hole causing sides of hole portion 70 to squeeze second portion 60 of the anchor pivot. Accordingly, anchor pivot 50 collapses causing opening 64 to become temporarily smaller. Tuft 30 is then pushed all the way into hole 40 (Fig. 16C) at which point the resilient plastic anchor pivot springs back to its form shown in Fig. 16A. This paragraph describes a snap-fit retention of tuft 30 to the head.

Referring to Fig. 16C, base support 48 is longer in the A dimension than hole portion 70 and thus prevents tuft 30 from being pressed further into hole 40. Second portion 60 is also longer in the A dimension than hole portion 70 and so prevents tuft 30 from moving back out of hole 40. This is due to the fact that lips 63 (Fig. 8) engage lips 73 (Fig. 11). This arrangement also prevents tuft 30 from rotating about the long axis of the bristles.

As shown in Fig. 15, tuft 30 pivots when it is engaged by, for example, portions of the oral cavity during brushing. Preferably each tuft 30 can pivot up to about 15 degrees to either side of a position perpendicular to surface 66.



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Turning to Figs. 17 and 18, another type of tooth cleaning element in the form of a fin 80 is disclosed. Each fin is supported by a base support 48 and an anchor pivot 50 (both not shown) as described above, allowing the fin to pivot on the brush head. Alternatively, a fin can be securely affixed to the head so that it does not pivot. The fin is created of a thermoplastic elastomer (TPE) by an injection molding process. In this embodiment, a textured surface is provided by a series of ribs 82. These ribs enhance cleaning of the oral cavity. The ribs are formed by injection molding a TPE over the fin. The ribs are preferably softer than the fin. Alternative textured surfaces (e.g. dimples) can be used in place of the ribs.

10 As shown in Fig. 18, the fin has a width of preferably about .030 inches. The long dimension of the fin above the base support is preferably .420 inches. A tip 84 of fin 80 has a width of preferably .007 inches. The distance from the base of the ribs to tip 84 is about .168 inches whereas the distance from the top of the ribs to the tip is about .079 inches. The top of the ribs have a width of about .035 inches. The ribs (textured surface) preferably extend about 2-12 mil away from said fin.

Fig. 19 is a partial sectional view of a toothbrush showing another embodiment of the invention. A head 90 and all of the tooth cleaning elements projecting from the head are the same as shown in Fig. 1. A handle 92 encloses a 1.5 volt triple A battery 94 and a motor 96. An eccentrically mounted weight 98 is secured to a drive shaft 100 which projects from the motor. An on/off switch 102 projects slightly out of the handle.

When the on/off switch is depressed a first time, an electrical circuit between battery 94 and motor 96 is completed causing the motor to rotate shaft 100. The shaft preferably rotates at between about 9700-12,400 rpm. Weight 98 is thus also rotated. As the weight is eccentrically mounted, rotating the weight causes a vibration which is transmitted to handle 92, head 90 and the tooth cleaning elements on the head.

One type of motor which can be used is a P/N Q6DL-2.6A with a # 17 counterweight attached. This motor was bought from Jin Long Machinery, 640 Dean Street, Brooklyn, NY 11238 (718.783.2328). Also see [www.vibratormotor.com](http://www.vibratormotor.com).

30 It should be noted that tooth cleaning elements 28 (Fig. 3) are oriented at an acute angle relative to that portion of a top surface of head 16 from which elements

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28 project. In another embodiment of the invention, one or more of tooth cleaning elements 34, 36 and 38 can also be oriented at an acute angle to the top surface of head 16. The tooth cleaning elements can be oriented at two or more different angles and can also be angled in different directions such as along the length of the head, across the width of the head or part way between the length and width of the head (a compound angle). The tooth cleaning elements are preferably at an angle of between about 65-85 degrees measured from a line parallel or tangent to the top surface of the head.

10 All of tooth cleaning elements 28, 30, 34, 36 and 38 also have a non-circular cross-sections (see Fig. 2). Elements 30, 34 and 38 have cross-sections that can be described as a prolate ellipsoid with flattened long sides. Element 28 has a free end that defines a plane 28A which is non-perpendicular to a direction 28B in which element 28 extends away from head portion 20. The free end of element 28 can alternatively have a non-flat shape (e.g. curved) which can be formed by a hot tufting or spool feed tufting manufacturing process.

As shown in Fig. 3, the various tooth cleaning elements 28, 30, 34, 36 and 38 extend different heights above head 16. These elements also have several different cross-sections. In an alternative embodiment, the elements can also be at a number of different acute angles relative to the top surface of the head.

20 Further, one or more of these tooth cleaning elements can be replaced by a tooth cleaning element which is made of a thermoplastic elastomer. The thermoplastic elastomer tooth cleaning element can be a unitary structure, or it can be made up of a number of substructures. For example, the thermoplastic elastomer element could be a large unitary bristle (i.e. a nub) or it could have a number of smaller bristles (e.g. a tuft of bristles). The element could also be in the shape of a fin (as in Fig. 18), cup (e.g. prophyl cup) or wall (curved or straight).

30 Different types of bristles which can be used on the toothbrush are bristles which (a) are tapered at their free end, (b) are flagged at their free end, (c) are hollow (see e.g. US Patent 5,836,769), (d) are crimped (see e.g. US Patent 6,058,541), (e) have a cross-shaped or triangular cross-section, (f) are flocked, or (g) are notched (see e.g. US Patent 6,018,840).

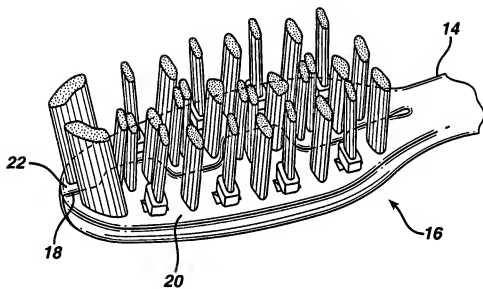
A tuft of bristles can alternatively have bristles made of different

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materials (e.g. some bristles made of nylon and other bristles made of polybutylene terephthalate) or bristles having different diameters.

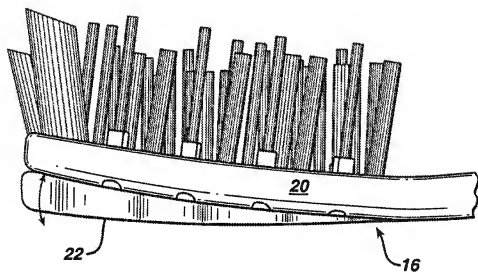
Further, the plastic head can alternatively be covered partially or completely in a thermoplastic elastomer which acts to protect the teeth and gums from the plastic head. This results in a head made of two materials. Additional types of materials could also be provided on the head.

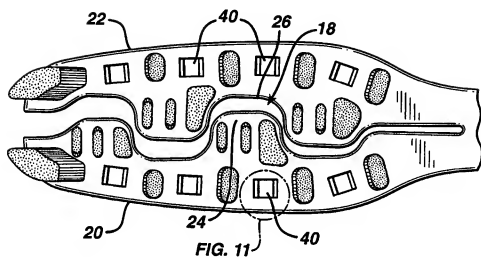
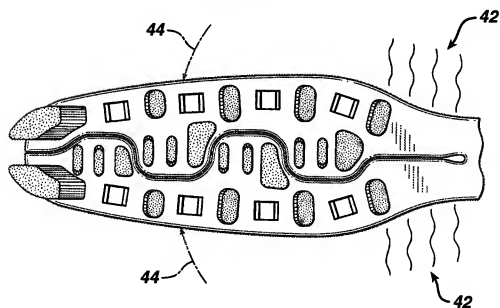
**FIG. 1**



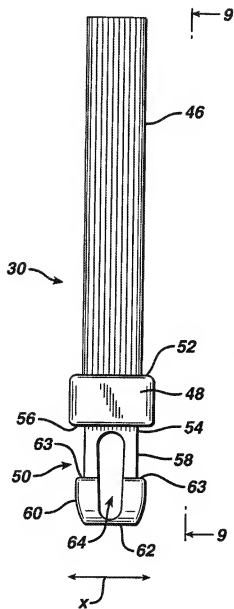


**FIG. 5**

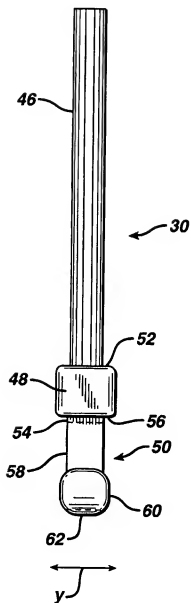


**FIG. 6****FIG. 7**

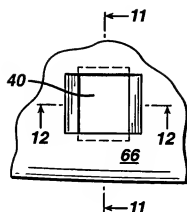
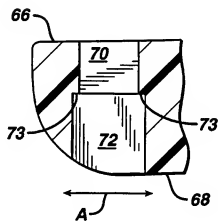
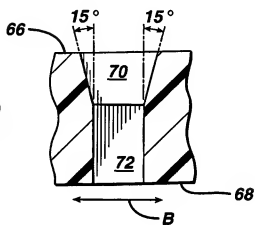
**FIG. 8**

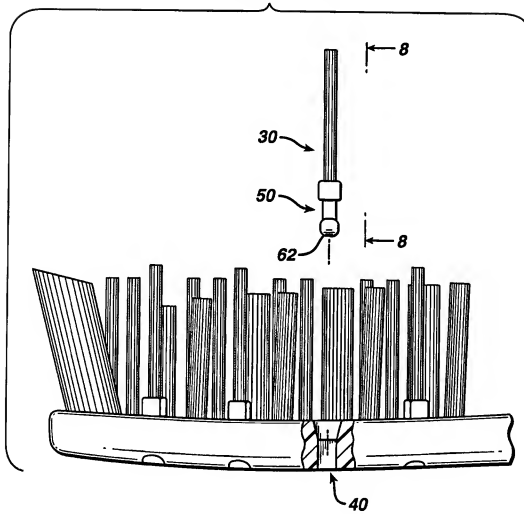


**FIG. 9**

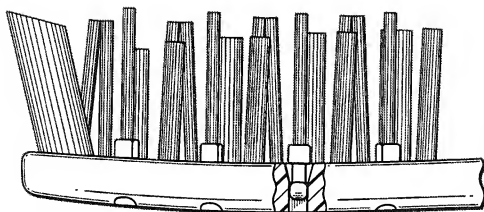




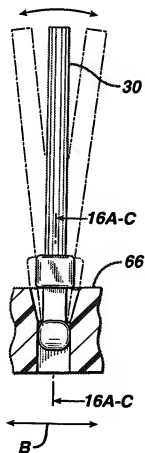
**FIG. 10****FIG. 11****FIG. 12**

**FIG. 13**

**FIG. 14**



**FIG. 15**



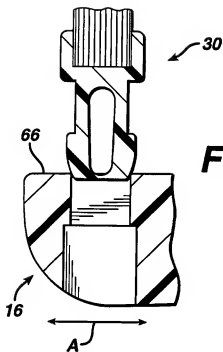


FIG. 16B

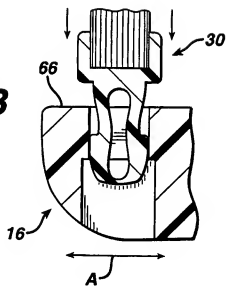
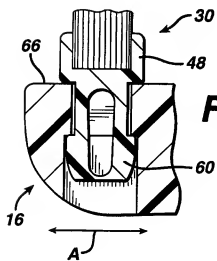
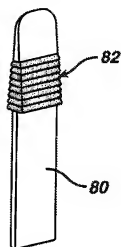


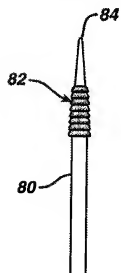
FIG. 16C



**FIG. 17**



**FIG. 18**



**FIG. 19**